Era Aviation Inc.

PROCESS SPECIFICATION

PROCESS SPECIFICATION NO. PS4012

REPAIR PROCEDURES FOR HIGH TEMPERATURE WELDED STEEL ASSEMBLIES

Prepared By: _____ Date: 07/19/02
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Approved By:
Quality Control: Dave Murphy Date: 7/19/02
Dave Murphy

Engineering: _____ Date: 07/25/02
Peter Schwartz

LOG OF REVISIONS

REVISION	DATE	PAGES AFFECTED	REVISION DESCRIPTION	APPROVED DATE
IR	D. Marwill 07/19/02	ALL	Initial Release	P. Schwartz & D. Marwill 07/25/02
A	D. Marwill 05/03/04	B, 6, 9	Added new repair for cracking in existing holes.	P. Schwartz 05/20/04
B	D. Marwill 10/01/04	Revised B. Added 10 & 11.	Added new repair schemes for model S-76 and BO-105 exhaust pipes.	P. Schwartz 10/27/04
C	D. Marwill 05/09/05	A, B, C, D, 1, 4, 8, 11, 12, 13, 14, and 15.	1. Changed title of specification. 2. Updated Figure 7-2 to allow additional flange repairs. 3. Added sections 6.4 and 8 for repairs of bleed air plumbing.	P. Schwartz 05/09/05 D. Marwill 05/09/05

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1 SCOPE

This document describes the materials, processes, standards and procedures necessary to perform approved repairs on welded steel part assemblies.. This specification covers engine exhaust ducts and bleed air tube assemblies made of a variety of different high temperature compatible stainless steel metals.

2 PURPOSE

The purpose of this process specification is to provide an approved method and procedures for repairing turbine engine exhaust ducts (pipes) and bleed air tube assemblies used on most aircraft. This document ensures that proper materials, correct procedures, and qualified personnel are used to produce the highest quality repaired part.

3 APPLICABLE DOCUMENTS

The following documents form an integral part of this specification. In all cases, the most current revision of the noted document is applicable.

3.1 Era Process Specification No. 4001, Gas Tungsten Arc Welding

3.2 MIL-STD-2219, Fusion Welding for Aerospace Applications

3.3 MIL-STD-1595, Aerospace Welder Performance Qualification

3.4 AWS A2.0-68, Standard Welding Systems

3.5 Report 97-H-002, Fusion Welding and Salvage Repair of a Welded Exhaust Duct Assembly

4 RECEIVING INSPECTION

4.1 Identification of Parts

The exhaust duct or bleed air tube assembly part to be repaired shall be identified by OEM manufacturer and manufacturer's part number. If a serial number for the part is assigned by the manufacturer, note the serial number on the repair order.

4.2 Material Identification

Using the manufacturer's part number, determine the type of material (stainless steel, titanium, etc.) to be repaired by welding. Note the material type on the repair order.

4.3 Pre-Inspection Cleaning

4.3.1 Clean titanium, inconel, low alloy steel, and stainless steel parts by wiping with MEK followed by Oaklite 214M or equivalent.

4.3.2 Rinse with warm soapy water.

4.3.3 Rinse with clean water.

4.3.4 Wipe dry with a clean cloth.

4.4 Visual Inspection

Visually inspect the part to be repaired for cracks, missing pieces/parts, dents, and material erosion heat damage. Examine any previous repairs for condition. All discrepancies shall be noted on the repair order.

4.5 Penetrant Inspection

4.5.1 Dye penetrant inspect all existing welds per MIL-STD-6866. Make note of any discrepancies on the repair order.

4.5.2 Steam clean the part to remove the penetrant and blow dry using compressed air.

5 PREPARATION FOR REPAIR

5.1 Personnel

This specification provides for repairs by gas tungsten arc welding only. Therefore, the welder must be qualified in accordance with MIL-STD-1595, except re-examination shall be every twelve (12) months.

5.2 Welder Certification

Verify that the welder possess current certification in accordance with Process Specification 4001, Section 7, for the weld joint being welded.

5.3 Parts Preparation

5.3.1 Surfaces to be welded shall be free from grease or other foreign matter. The parts should be cleaned to bright metal using abrasive paper or a wire brush. See PS4001, Section 6 for details.

CAUTION

If a wire brush is used, the wire material must be similar to the composition of the material being welded.

The area to be welded shall be bright for at least a distance of 0.4 inches around or on either side of the damaged area.

5.3.2 All parts or assemblies are required to be cleaned prior to welding to remove oxides and contamination. Surface contamination may cause excess porosity and inclusions which would degrade the weld quality. See PS4001, Section 6 for details.

5.4 Holding Devices

Suitable jigs, clamping devices, and tack welding may be used to prevent warping and ensure fit-up and proper alignment.

6 REPAIR METHODS

6.1 General Repairs

Many aircraft manufacturers provide a structural repair document. For example, Bell Helicopter Model 412 Maintenance Manual BHT-412-MM-9, Section 71-152 provides repair information for exhaust ducts. A manufacturer's structural repair document should be consulted for applicable information on how to repair specific damage to parts.

If a structural repair document is not available or if it does not provide applicable repair information, proceed to Section 6.2 or 6.3.

6.2 Repair of Bell 212 and 412 Engine Exhaust Ducts

If the aircraft part to be repaired is a Bell Helicopter Model 212 or 412 engine exhaust duct, consult B & O Aircraft Ltd. Engineering Report 97-H-002 for additional repair details.

6.3 Repairs to Other Exhaust System Parts

If the exhaust system part to be repaired is not covered by Sections 6.1 or 6.2, proceed to Section 7 of this document. Section 7 is a generic repair procedure for making repairs by welding on most engine exhaust ducts.

6.4 Repairs to Bleed Air Plumbing Assemblies

Proceed to Section 8 of this document for generic repairs to bleed air tube and flexible hose assemblies.

7 REPAIR PROCEDURES – EXHAUST SYSTEM ASSEMBLIES

7.1 General

7.1.1 This section contains generic repair procedures for repairing engine exhaust system parts.

7.1.2 Complete the procedures found in Sections 4 and 5 of this document.

7.1.3 Identify the specific kind of defect in the part and refer to that paragraph in Section 7 below.

7.2 Minor Cracks

7.2.1 If the crack is less than 4 inches long, align the edges of the metal so they are at the same elevation. Clamp in place if necessary. If the crack does not extend to a part edge, weld in accordance with Era PS4001, Class C.

7.2.2 If the crack does extend to the part's edge, refer to Section 7.3.

7.3 Major Cracks

7.3.1 If the crack is longer than 4 inches and/or extends to the part's edge, prepare a patch to be placed over the crack.

7.3.2 The patch shall be made of the same material type as the base material. The thickness shall be the same as the base material or up to one gauge thinner. Refer to PS4001, Tables 8-3 and 8-4 for a list of base materials. If the base material is not listed in these tables, refer to Society of Metals Manuals "Worldwide Guide to Equivalent Irons and Steels" or "Worldwide Guide to Equivalent Non Ferrous Metals and Alloys" for information to cross reference the part's material specification to a comparable United States material specification.

7.3.3 Cut out the patch from an appropriate flat sheet stock. The size and shape shall be roughly the same as the crack and approximately 0.5 to 0.8 inches overlapping. This will allow the new weld material to be attached to unfatigued material. The corners of the patch shall be made with the largest practical radius.

7.3.4 Weld the patch to the original base material per Era PS4001, Class C.

7.4 Broken Material

Broken material describes a damaged part condition where there are multiple cracks or breaks in the metal in a localized area. In this case, the repair procedure is as follows:

7.4.1 Cut and remove the broken (damaged) material from the part.

7.4.2 Fabricate a similar shaped piece from the same material and thickness as the base material. The air gap between the edges of the new material and original material shall not exceed .04 inches (reference Figure 7-1).

7.4.3 Secure the new material in place and weld per Era PS4001, Class C.

7.5 Holes

7.5.1 Holes created by cracking may be repaired by installing a patch. Cut out the patch from an appropriate flat sheet stock. The size and shape shall be roughly the same as the hole and approximately 0.5 to 0.8 inches overlapping. This will allow the new weld material to be attached to unfatigued material. The corners of the patch shall be made with the largest practical radius. A circle is the most desirable shape. See Figure 7-2 for examples.

7.5.2 Existing holes which have cracks emanating from their edges may be repaired as shown on Page 9, Dwg S7671-722. Fabricate parts and assemble as shown and noted on Dwg S7671-722.

7.5.3 Weld the patch to the original base material per Era PS4001, Class C.

7.6 Stiffener Band Repair

Many exhaust ducts have stiffener bands or reinforcement rings outside or inside the duct. A proposed repair sketch shall be created and submitted to a structural DER for review and approval before a repair can be authorized.

7.7 Mounting Flanges

Many exhaust ducts have thick mounting flanges which may have multiple holes for attaching the part to an engine. Should a crack develop, a proposed repair sketch shall be created and submitted to a structural DER for review and approval before a repair can be authorized.

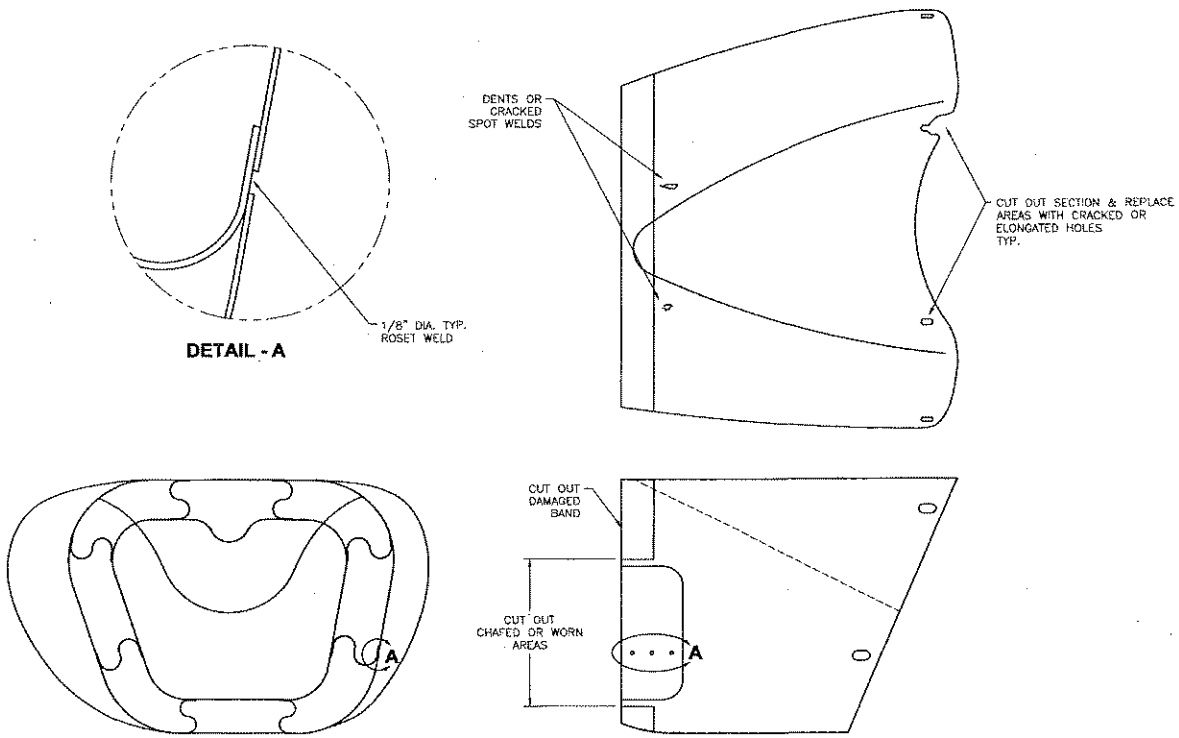


FIGURE 7-1
TYPICAL REPAIRS TO
A MODEL S-76 ELONGATOR

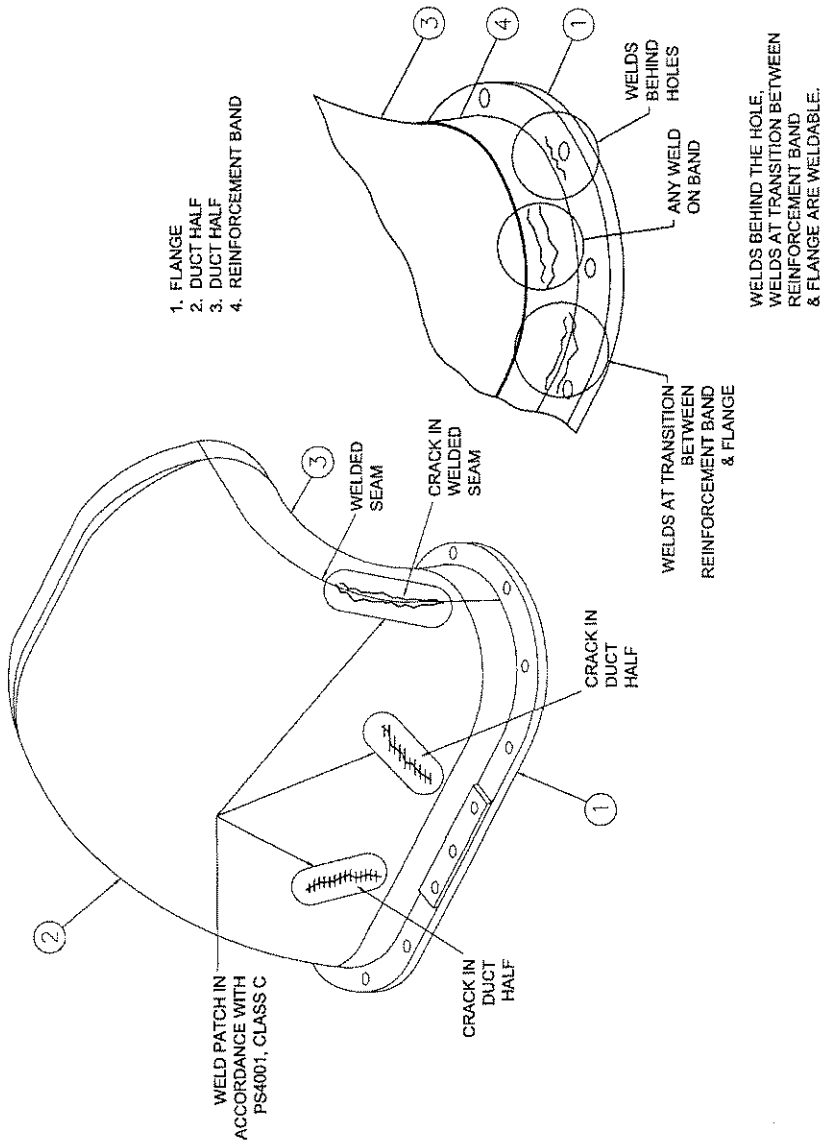


FIGURE 7-2
TYPICAL REPAIRS TO A BELL PT6B ENGINE EXHAUST DUCT

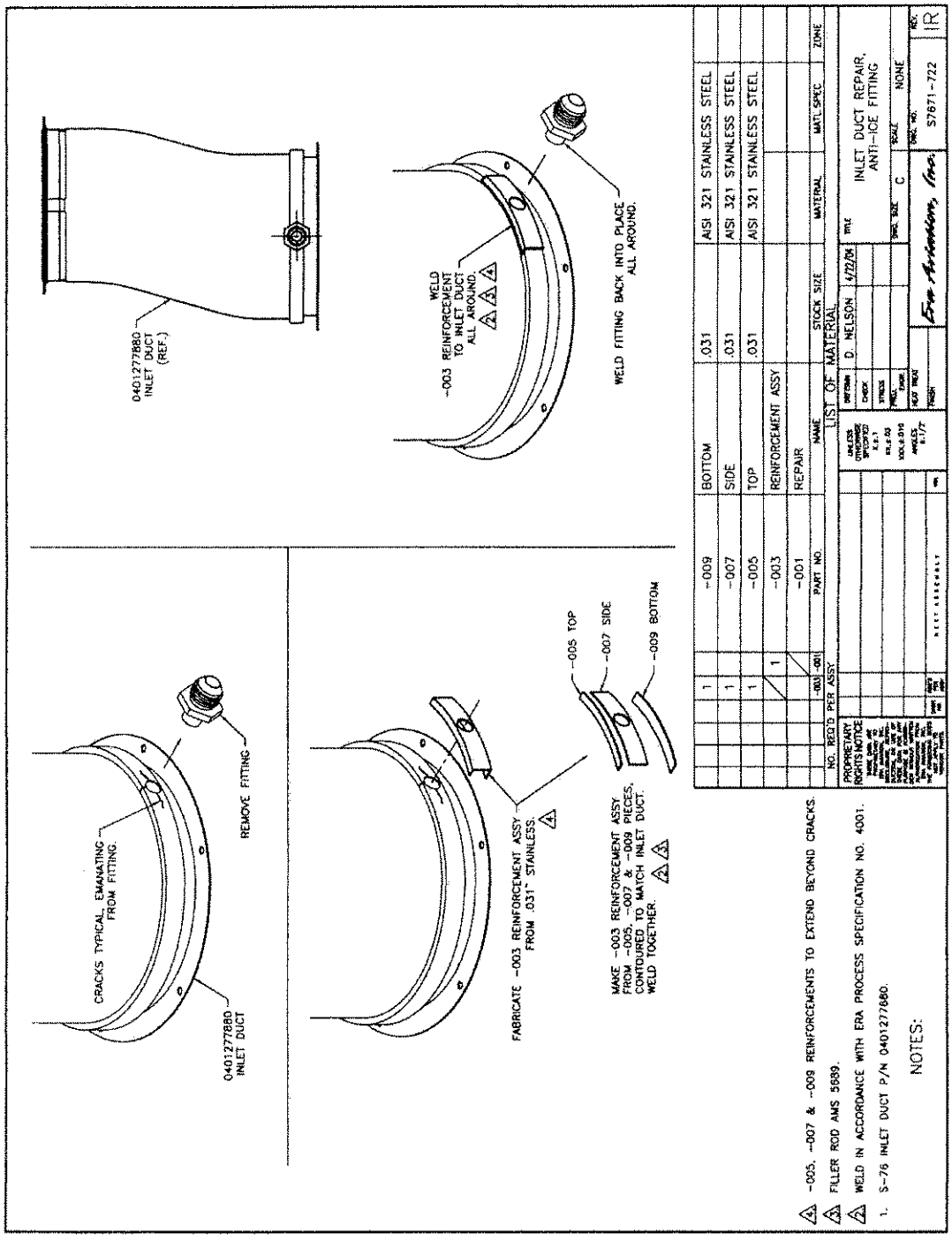


FIGURE 7-3
REPAIRS TO A MODELS S-76 EXHAUST

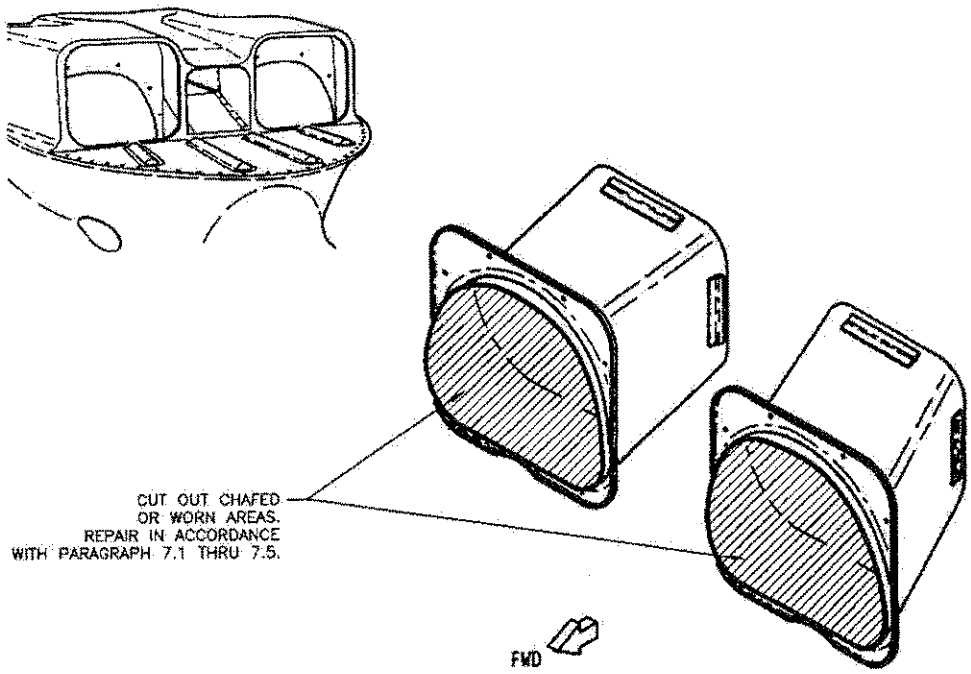


FIGURE 7-4
TYPICAL REPAIRS TO
A MODEL S-76 EXHAUST EJECTOR

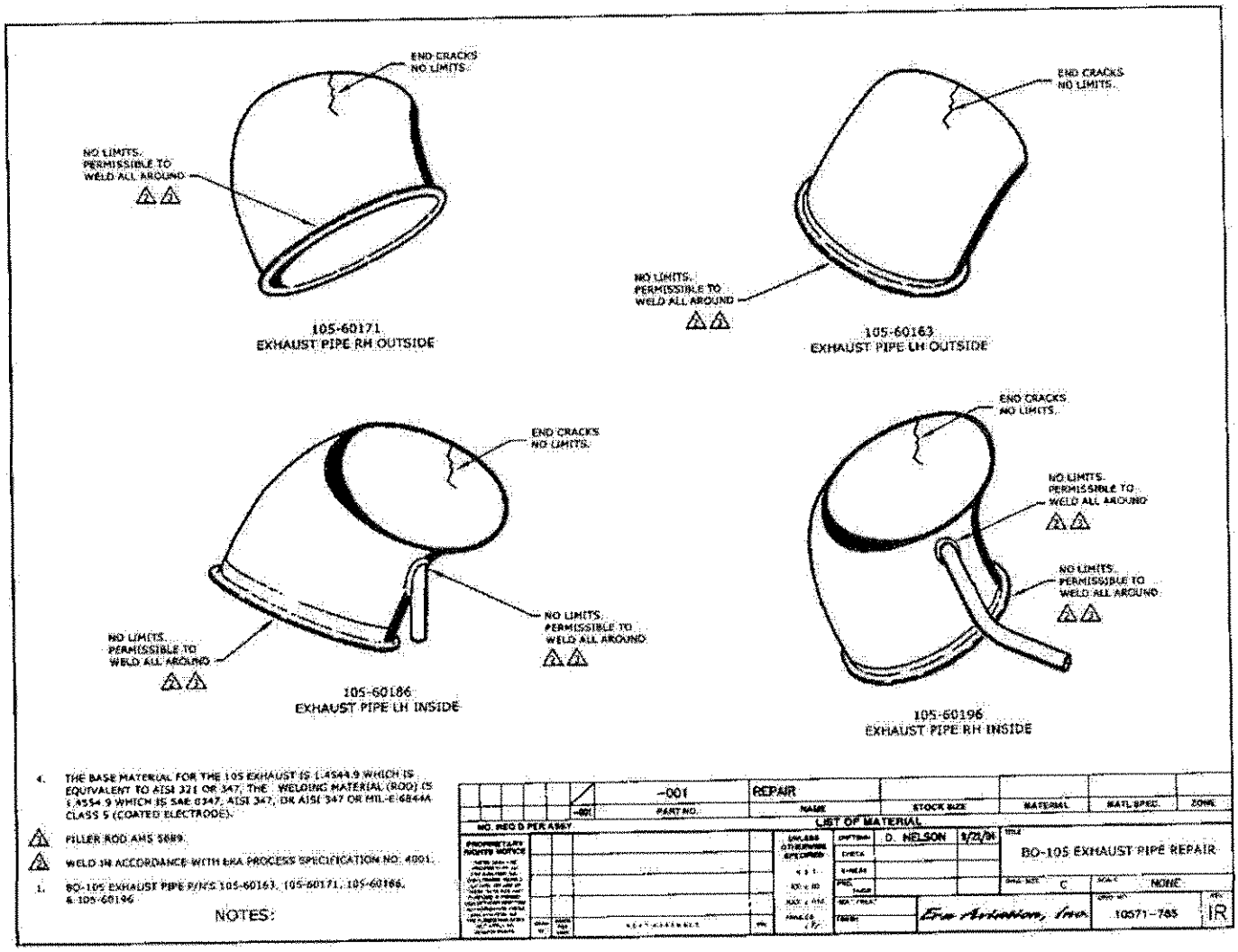


FIGURE 7-5

TYPICAL REPAIRS TO A MODEL BO-105 EXHAUST PIPE

8 REPAIR PROCEDURES – BLEED AIR TUBE AND FLEXIBLE HOSE ASSEMBLY

8.1 General

8.1.1 This section contains generic repair procedures for repairing welded steel bleed air plumbing (tubing) with or without steel flexible hose assemblies attached.

8.1.2 Complete the procedures found in Section 4 and 5 of this document first.

8.1.3 If the welded bleed air plumbing assembly consists of only steel tubing with fittings on the ends, refer to Section 8.2 of this document.

8.1.4 If the welded bleed air plumbing consists of a welded steel tube(s) attached to a steel flexible hose assembly, refer to Section 8.3 of this document.

8.2 Steel Tubing Assemblies

8.2.1 The damaged tube assembly may be repaired a shown in Figures 8-1 and 8-2. The tube may be cut and a new welded section inserted approximately where shown by delta note 1 in Figures 8-1 and 8-2.

8.2.2 Use only the tube stock and end fittings identified on Figures 8-1 and 8-2 for repair materials. All welding and processing shall be in accordance with Process Specification PS4001.

8.3 Steel Tubing with Flexible Hose Assemblies Attached

8.3.1 The steel tubing portion of the assembly shall be repaired in accordance with Section 8.2 of this document.

8.3.2 Flexible hoses may be attached to steel tubing per the information provided in Figure 8-3.

8.3.3 All flexible hose material and end fittings shall be Aerospace 145 series components (part no. S145-xx) manufactured by Titflex Corp., Springfield, MA. Flexible hose end fittings are 37° flared fittings which mate with MS33656 threads.

8.4 Pressure Tests

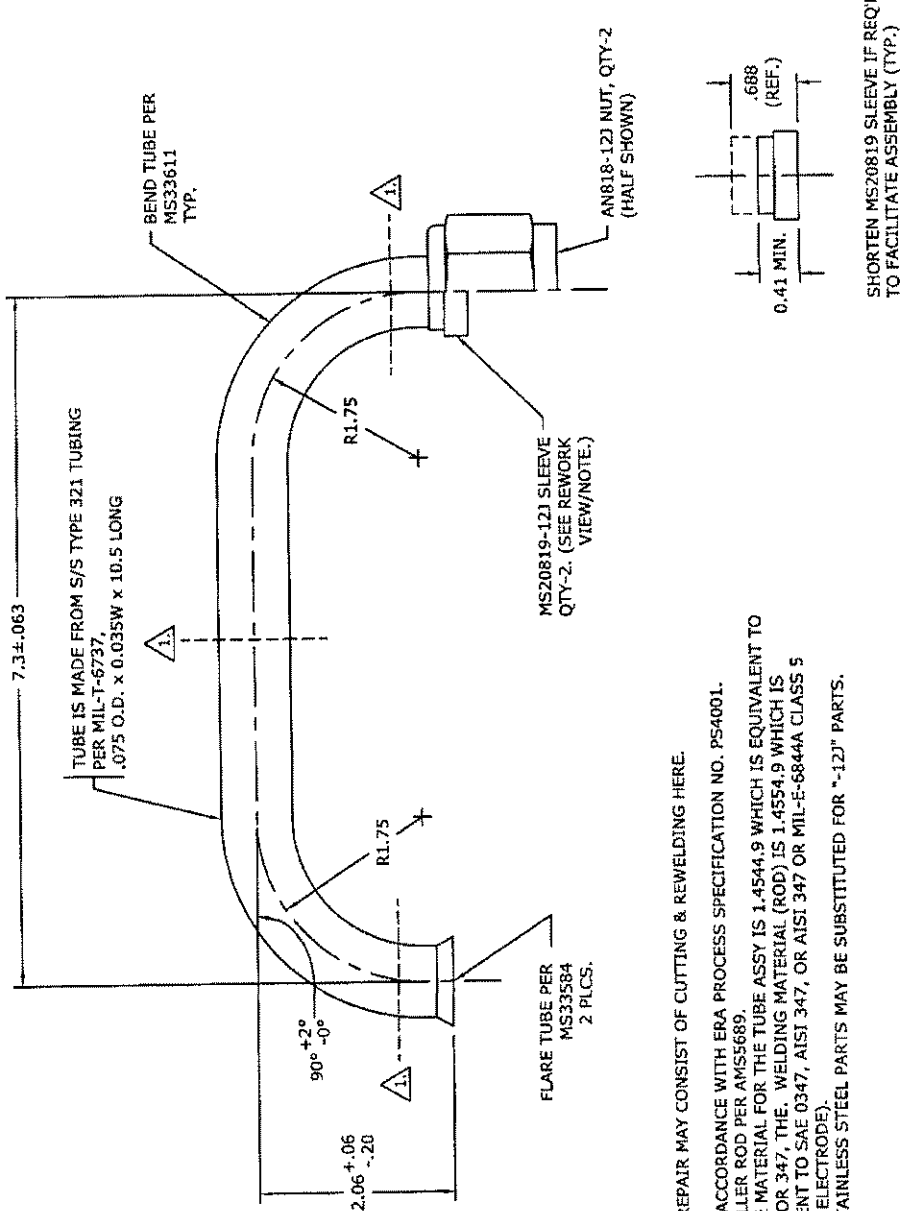
8.4.1 All tube assemblies repaired per Section 8.2 and flexible hose/tube assembly combinations repaired per Section 8.3 shall be pressure tested for leaks.

8.4.2 Attach appropriate size AN806 plugs and one AN919 reducer to the ports on the assembly. Connect a suitable flexible hose to a regulated air pressure source.

8.4.3 Submerge the assembly into a container of water.

8.4.4 Pressurize the assembly to 160 psig (150% of normal maximum). Examine the assembly for any evidence of air bubbles, indicating a leak.

8.4.5 If there are leaks, repair and retest the assembly. If there are no leaks, air dry the assembly before storage or use.

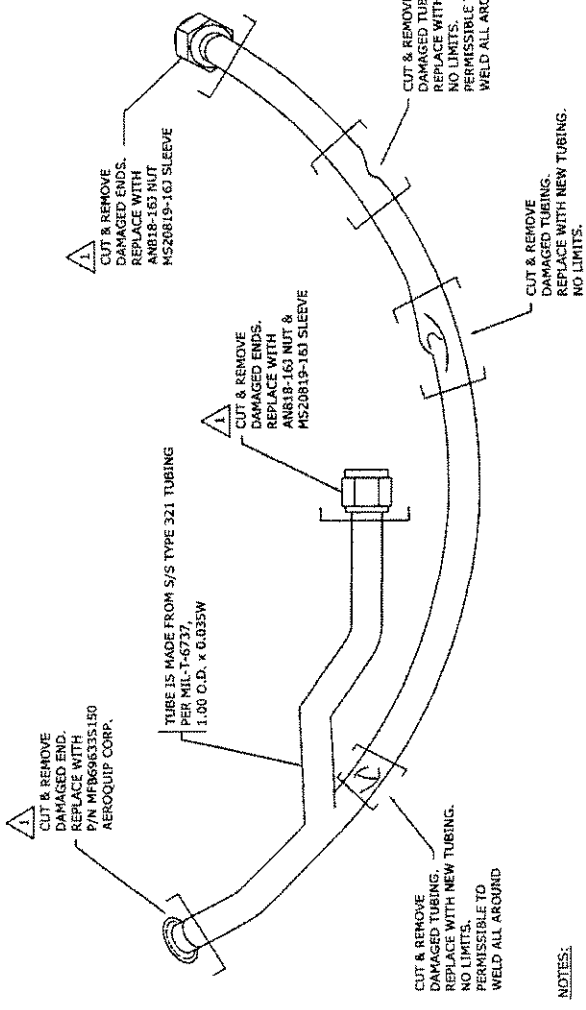


NOTES:

1. TYPICAL REPAIR MAY CONSIST OF CUTTING & REWELDING HERE.
2. WELD IN ACCORDANCE WITH ERA PROCESS SPECIFICATION NO. PS4001.
3. USING FILLER ROD PER AMS5689.
   THE BASE MATERIAL FOR THE TUBE ASSY IS 1.4544.9 WHICH IS EQUIVALENT TO AISI 321 OR 347, THE. WELDING MATERIAL (ROD) IS 1.4554.9 WHICH IS EQUIVALENT TO SAE 0347, AISI 347, OR AISI 347 OR MIL-E-6844A CLASS 5 (COATED ELECTRODE).
4. "-12K" STAINLESS STEEL PARTS MAY BE SUBSTITUTED FOR "-12J" PARTS.

TYPICAL REPAIRS TO A
105-E0022-5 TUBE ASSY

FIGURE 8-1

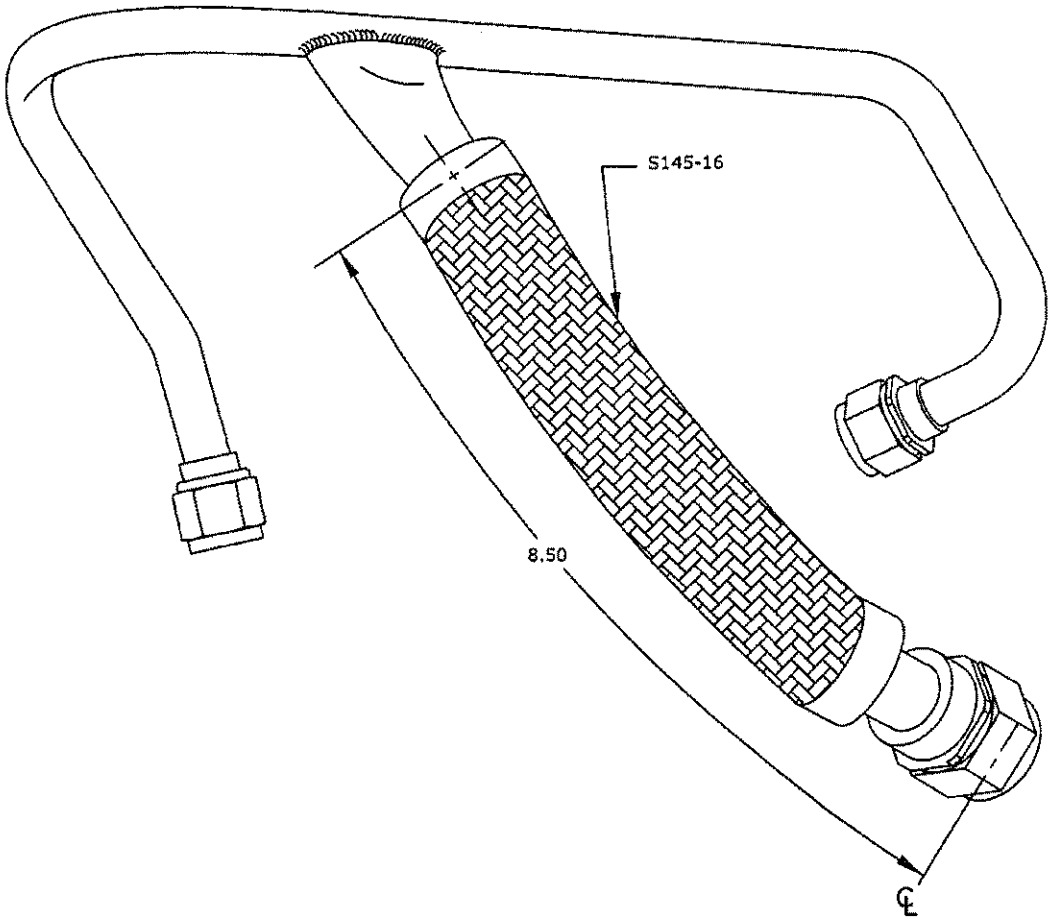


NOTES:

1. TYPICAL REPAIR MAY CONSIST OF CUTTING & REWELDING HERE.
2. WELD IN ACCORDANCE WITH ERA PROCESS SPECIFICATION NO. PS4001.
3. USING FILLER ROD PER AMS5689.
4. THE BASE MATERIAL FOR THE TUBE ASSY IS 1.4544.9 WHICH IS EQUIVALENT TO AISI 321 OR 347. THE WELDING MATERIAL (ROD) IS 1.4554.9 WHICH IS SAE 0347, AISI 347, OR AISI 347 OR MIL-E-6844A CLASS 5 (COATED ELECTRODE).
5. 12K STAINLESS STEEL PARTS MAY BE SUBSTITUTED FOR 12J PARTS.

TYPICAL REPAIRS TO A
C-105-20-50000-48 ECU TUBE ASSY

FIGURE 8-2



NOTES:

1. 37° FLARE MATES WITH MS33656. TYP.
2. HOSE ASSEMBLY TO BE DEBURRED AND FREE OF ALL CONTAMINANTS.
3. MATERIALS TO CONFORM TO MIL-T-8808 AI. S/S OR EQUIV. (TUBING).
4. ASSEMBLY TO BE IN ACCORDANCE WITH SAE AS1424.
5. WELD TO STANDARD MIL-W-8611 OR MIL-STD-1595 OR ERA PROCESS SPECIFICATION 4001.
6. PRESSURE TEST TO 160 PSIG FOR ONE MINUTE (MINIMUM).
7. USE TITEFLEX S145-16 STRAIGHT FITTINGS.

TYPICAL REPAIRS OF EUROCOPTER
PART NO. C105-20-50000-51 & -52
FLEXIBLE HOSE ASSEMBLY

FIGURE 8-3